

## AMENDMENTS TO THE CLAIMS

1. (Original) A computer-implemented method for approximating a function of an input argument, comprising:

selecting one of a plurality of breakpoints, such that a reduced argument for the function is less than a predetermined value; and

evaluating an approximate function of the reduced argument, including accessing a look-up table based on the selected breakpoint to obtain a value of a term in the approximate function,

wherein the look-up table has at least one breakpoint for which the reduced argument can be computed without roundoff error when the input argument is close to a root of the function.

2. (Original) The method of claim 1 wherein the function is  $\log_b(X)$ .

3. (Currently Amended) The method of claim 2 further comprising:

representing  $X$  in the floating point form  $Y \cdot G^k$  where  $Y$  is greater than or equal to 1 and  $G$  is a positive integer larger than  $Y$ , and wherein the reduced argument is  $Z = C \cdot (Y \cdot B_j - 1)$  where  $B_j$  is any of the plurality of breakpoints and  $C$  is a function of  $\log_b(e)$ , and evaluating the approximate function includes determining  $\log_b(1/B_j)$  using the look-up table and determining  $\log_b(X)$  as an arithmetic combination of at least  $k \cdot \log_b(2)$ ,  $\log_b(1/B_j)$ , and  $\log_b(1 + Z/C)$ .

4. (Currently Amended) The method of claim 3 wherein  $\forall \leq 2Y$  is equal to or less than 2 and the look-up table is modified such that  $B_0 = 1$  and  $B_N = 1/2$ .

5. (Original) The method of claim 3 wherein  $\log_b(1/B_j)$  is given by the look-up table as at least two lower precision values  $T_{j,hi}$  and  $T_{j,lo}$  whose sum equals  $\log_b(1/B_j)$ ,  $\log_b(2)$  is given by at least two lower precision values  $L_{hi}$  and  $L_{lo}$  whose sum equals  $\log_b(2)$ , and  $Z$  is given by at least two lower precision values  $Z_{hi}$  and  $Z_{lo}$  whose sum equals  $Z$ .

6. (Original) The method of claim 5 wherein  $\log_b(X)$  is approximated by  $A_1 + A_2 + Z_{lo}$ , where  $A_1$  is  $k \cdot L_{hi} + T_{j,hi} + Z_{hi}$ ,  $A_2$  is  $k \cdot L_{lo} + T_{j,lo} + P$  and  $P$  is  $\log_b(1 + Z/C) - Z$ .

7. (Original) The method of claim 6 wherein if  $k*N+j=0$  for the breakpoint, then  $\log_b(X)$  is approximated by  $(A_1+Z_{10})+A_2$ .

8. (Original) The method of claim 7 wherein  $\log_b(X)$  is otherwise given by  $A_1 + (A_2+Z_{10})$ .

9. (Original) The method of claim 3 wherein the predetermined value is proportional to  $1/(2*N)$ .

10. (Original) The method of claim 9 wherein  $k*L_{hi}+T_{j,hi}$  can be represented without roundoff error for all valid values of  $k,j$ .

11. (Original) The method of claim 10 wherein  $T_{0,hi}=T_{0,lo}=0$  and  $T_{N,hi}=L_{hi}$ ,  $T_{N,lo}=L_{lo}$ .

12. (Original) An article of manufacture, comprising:  
a machine readable medium having instructions stored therein that can be executed by a processor to approximate a function of an input argument by selecting one of a plurality of breakpoints, such that a reduced argument for the function is less than a predetermined value, and evaluating an approximate function of the reduced argument including accessing a look-up table based on the selected breakpoint to obtain a value of a term in the approximate function, wherein the look-up table has at least one breakpoint for which the reduced argument can be computed without roundoff error when the input argument is close to a root of the function.

13. (Original) The article of manufacture of claim 12 wherein the function is  $\log_b(X)$ .

14. (Currently Amended) The article of manufacture of claim 13 wherein the medium has further instructions for representing  $X$  in the floating point form  $Y*G^k$  where  $Y$  is greater than or equal to 1 and  $G$  is a positive integer larger than  $Y$ , and wherein the reduced argument is  $Z=C*(Y*B_j-1)$  where  $B_j$  is any of the plurality of breakpoints and  $C$  is a function of  $\log_b(e)$ , and evaluating the approximate function

includes determining  $\log_b(1/B_j)$  using the look-up table and determining  $\log_b(X)$  as an arithmetic combination of at least  $k \cdot \log_b(2)$ ,  $\log_b(1/B_j)$ , and  $\log_b(1+Z/C)$ .

15. (Currently Amended) The article of manufacture of claim 14 wherein  $\frac{Y}{2} \leq Y$  is less than or equal to 2 and the look-up table is modified such that  $B_0=1$  and  $B_N=1/2$ .

16. (Original) The article of manufacture of claim 13 wherein  $\log_b(1/B_j)$  is given by the look-up table as at least two lower precision values  $T_{j,hi}$  and  $T_{j,lo}$  whose sum equals  $\log_b(1/B_j)$ ,  $\log_b(2)$  is given by at least two lower precision values  $L_{hi}$  and  $L_{lo}$  whose sum equals  $\log_b(2)$ , and  $Z$  is given by at least two lower precision values  $Z_{hi}$  and  $Z_{lo}$  whose sum equals  $Z$ .

17. (Original) The article of manufacture of claim 16 wherein  $\log_b(X)$  is approximated by  $A_1 + A_2 + Z_{lo}$ , where  $A_1$  is  $k \cdot L_{hi} + T_{j,hi} + Z_{hi}$ ,  $A_2$  is  $k \cdot L_{lo} + T_{j,lo} + P$  and  $P$  is  $\log_b(1+Z/C) - Z$ .

18. (Original) The article of manufacture of claim 17 wherein if  $k \cdot N + j = 0$  for the breakpoint, then  $\log_b(X)$  is approximated by  $(A_1 + Z_{lo}) + A_2$ .

19. (Original) The article of manufacture of claim 18 wherein  $\log_b(X)$  is otherwise given by  $A_1 + (A_2 + Z_{lo})$ .

20. (Original) The article of manufacture of claim 14 wherein the predetermined value is proportional to  $1/(2 \cdot N)$ .

21. (Original) The article of manufacture of claim 20 wherein  $k \cdot L_{hi} + T_{j,hi}$  can be represented without roundoff error for all valid values of  $k, j$ .

22. (Original) The article of manufacture of claim 21 wherein  $T_{0,hi} = T_{0,lo} = 0$  and  $T_{N,hi} = L_{hi}$ ,  $T_{N,lo} = L_{lo}$ .

23. (Original) A computer system comprising:  
a processor coupled to a non-volatile storage device, the storage device contains instructions that when executed by the processor approximate a function of a number, by selecting one of a plurality of breakpoints, such that a reduced argument for the

function is less than a predetermined value, and evaluating an approximate function of the reduced argument including accessing a look-up table based on the selected breakpoint to obtain a value of a term in the approximate function, wherein the look-up table has at least one breakpoint for which the reduced argument can be computed without roundoff error when the input argument is close to a root of the function.

24. (Original) The computer system of claim 23 wherein the function is  $\log_b(X)$ .

25. (Currently Amended) The computer system of claim 24 wherein the storage device has further instructions that when executed by the processor represent  $X$  in the floating point form  $Y \cdot G^k$  where  $Y$  is greater than or equal to 1 and  $G$  is a positive integer larger than  $Y$ , and wherein the reduced argument is  $Z = C \cdot (Y \cdot B_j - 1)$  where  $B_j$  is any of the plurality of breakpoints and  $C$  is a function of  $\log_b(e)$ , and evaluating the approximate function includes determining  $\log_b(1/B_j)$  using the look-up table and determining  $\log_b(X)$  as an arithmetic combination of at least  $k \cdot \log_b(2)$ ,  $\log_b(1/B_j)$ , and  $\log_b(1 + Z/C)$ .

26. (Original) The computer system of claim 25 wherein  $\log_b(1/B_j)$  is given by the look-up table as at least two lower precision values  $T_{j,hi}$  and  $T_{j,lo}$  whose sum equals  $\log_b(1/B_j)$ ,  $\log_b(2)$  is given by at least two lower precision values  $L_{hi}$  and  $L_{lo}$  whose sum equals  $\log_b(2)$ , and  $Z$  is given by at least two lower precision values  $Z_{hi}$  and  $Z_{lo}$  whose sum equals  $Z$ .

27. (Original) The computer system of claim 26 wherein  $\log_b(X)$  is approximated by  $A_1 + A_2 + Z_{lo}$ , where  $A_1$  is  $k \cdot L_{hi} + T_{j,hi} + Z_{hi}$ ,  $A_2$  is  $k \cdot L_{lo} + T_{j,lo} + P$  and  $P$  is  $\log_b(1 + Z/C) - Z$ .

28. (Original) The computer system of claim 23 wherein the processor has a hardware architecture that is deeply pipelined and in which branch mispredictions cause a significant performance penalty.

29. (Original) The computer system of claim 28 wherein the processor is one of a plurality of IA-32 series of processors by Intel Corp.